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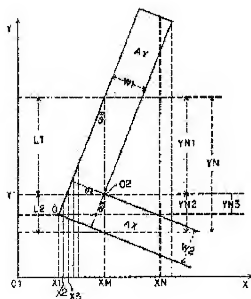
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(54) DRAWING MANAGING SYSTEM

(57)Abstract:

PURPOSE: To detect the reference coordinate point of a drawing at a high speed and to correct the inclination of an angle in the case of inputting the drawing at a high speed.

CONSTITUTION: The inside of a memory storing the picture elements of a drawing frame is scanned in an X direction while paying attention to drawing frames AX and AY are plotted in black, the number of black picture elements (histogram) in a Y direction is counted, and the coordinate point, where the histogram first continuously appears, is defined as a reference coordinate point O of the drawing. On the other hand, an inclining angle (correcting angle) θ in the case of inputting the drawing is calculated by a ratio between the number of scanned picture elements in the X direction and the value of the histogram in the Y direction, and the angle is corrected by rotation with the reference coordinate point as the center. Further, the drawing frames are spatially differentiated, line tracking is performed from the



reference coordinate point concerning this spatially differentiated image, the inclining angle is calculated, and the angle is corrected.

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- 3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1]An image reader which reads a drawing.

A memory which stores a pixel which constitutes a picture of a drawing read by this image reader.

A central processing unit which performs data processing between the above-mentioned image reader and the above-mentioned memory, etc.

It is the administration-of-drawings method provided with the above, a histogram about the number of pixels in the above-mentioned memory corresponding to a drawing frame drawn in a drawing by providing an image-processing exclusive processor is counted, and a normal coordinate point of a drawing is searched for based on this counted histogram.

[Claim 2]An image reader which reads a drawing.

A memory which stores a pixel which constitutes a picture of a drawing read by this image reader.

A central processing unit which performs data processing between the above-mentioned image reader and the above-mentioned memory, etc.

By being the administration-of-drawings method provided with the above, and providing an image-processing exclusive processor, A histogram about the number of pixels in the above-mentioned memory corresponding to a drawing frame drawn in a drawing is counted, A normal coordinate point of a drawing is searched for based on this counted histogram, It counts 1 pixel of pixels at a time for inside of a drawing horizontally to this normal coordinate point searched for, Also perpendicularly corresponding to horizontal counted value, a pixel is counted, and a correction angle for amending inclination between a actual drawing and a drawing read by the above-mentioned image reader based on a ratio of horizontal counted value to vertical counted value is searched for.

[Claim 3]An image reader which reads a drawing.

A memory which stores a pixel which constitutes a picture of a drawing read by this image reader.

A central processing unit which performs data processing between the above-mentioned image reader and the above-mentioned memory, etc.

By being the administration-of-drawings method provided with the above, and providing an

image-processing exclusive processor, A histogram about the number of pixels in the above-mentioned memory corresponding to a drawing frame drawn in a drawing is counted, A normal coordinate point of a drawing is searched for based on this counted histogram, spatial differentiation of the drawing frame is carried out, line tracking is performed from a normal coordinate point describing above about this spatial differentiation picture, and angle distortion at the time of a drawing input by the above-mentioned image reader is amended.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the administration-of-drawings method in the administration-of-drawings system which manages drawings, such as a map and a circuit diagram.

[0002]

[Description of the Prior Art] As drawings, such as a map and a circuit diagram, are generally shown in drawing 5, the drawing frame AV exists in the drawing P, and the figure is drawn in the drawing frame AV. When it stores this drawing P in the memory (not shown) of an administration-of-drawings system, the drawing P is read by image reader IR shown in drawing 6, and the white picture element and black pixel on the drawing P are identified and stored in a memory. Although the reading accuracy of image reader IR differs depending on the model of each image reader, generally the thing of 10 or more dots/mm of accuracy is used now. When reading the drawing P into image reader IR, along with the guide G1 of image reader IR, and G2, the drawing P is usually read, but it is impossible to make the drawing P read completely in parallel with the guide G1 and G2, and the frame and the guide G1 of the drawing P are usually read with the error of the minute angle theta.

[0003] For this reason, as shown in drawing 7, within a memory, the drawing P will be stored in the form where only theta shifted horizontally. Generally the coordinates (X, Y) of the point PO in the drawing P are expressed with the distance of the direction of X of the point PO, and the direction of Y by making into the starting point the point O in drawing 7 which the door post of the drawing P and a transversal frame cross. For this reason, if an error produces only angle theta as mentioned above, about an X coordinate, the error of $|a1-a2|$ will be produced [the case where the drawing frame AV is made into a normal coordinate]. It is the same also about a Y coordinate. In order to amend this error, the Hough (Hough) conversion algorithms are used conventionally. Namely, according to the formula of $\rho = X \cos \theta + Y \sin \theta$, and $\sin \theta$ of Hough transformation, the neighborhood A1 of the vertical axis of the drawing frame AV is scanned, Hough transformation is performed to each pixel of a drawing door post, and the error angle theta is amended from X and Y flat surface by changing into a flat surface (ρ , θ) and asking for the angle theta 1 (refer to drawing 8) to the error angle theta on a flat surface (ρ , θ). Since the algorithm of the inclination correction by Hough transformation is an algorithm generally used, explanation is omitted here.

[0004] The relation between a rectangular coordinate system and a polar coordinate system is shown in drawing 8. In the X-Y rectangular coordinate system shown in drawing 8(a), inclination and the point (X0, Y0) of as opposed to [in the distance to the straight line L and $\theta = 1 / \rho$] the X-axis of the altitude to the straight line L from the starting point show the intersection of the straight line L and an altitude. In the rho-theta polar coordinate system shown

in drawing 8 (b), a point (ρ_1, θ_1) shows the point corresponding to the point (X_0, Y_0) in drawing 8 (a). Therefore, a relation called $\rho_1 = X_0 \cos \theta_1 + Y_0 \sin \theta_1$ is materialized.

[0005]

[Problem(s) to be Solved by the Invention]As explained above, in order to perform inclination correction (angle correction) of a actual drawing and the drawing stored in the memory read by the image reader using Hough transformation, by the conventional administration-of-drawings method, trigonometric-functions calculation of $\cos \theta$ or $\sin \theta$ is needed. In order to perform such functional calculus at high speed, it is necessary to equip an administration-of-drawings system with the hardware only for functional calculus, and it will become expensive in cost. In order to realize by software using CPU in an administration-of-drawings system, it is necessary to perform math processing of $\cos \theta$ and $\sin \theta$ about each point on a straight line, and administration-of-drawings processing takes much time.

[0006]It was made in order that this invention might solve above SUBJECT, and it aims at providing the administration-of-drawings method which can amend inclination of the drawing at the time of an input at high speed while the normal coordinate point on a drawing is detectable at high speed.

[0007]

[Means for Solving the Problem]In an administration-of-drawings method concerning an invention of claim 1, by forming the image-processing exclusive processor 4, A histogram about the number of pixels in the memory 2 corresponding to a drawing frame drawn in a drawing is counted, and a normal coordinate point of a drawing is searched for based on this counted histogram.

[0008]In an administration-of-drawings method concerning an invention of claim 2, by forming the image-processing exclusive processor 4, Search for a normal coordinate point of a drawing and it counts 1 pixel of pixels at a time for inside of a drawing horizontally to this normal coordinate point searched for, Also perpendicularly corresponding to horizontal counted value, a pixel is counted, and a correction angle which amends inclination between a actual drawing and a drawing read by the image reader 1 is searched for based on a ratio of horizontal counted value to vertical counted value.

[0009]In an administration-of-drawings method concerning an invention of claim 3, by forming the image-processing exclusive processor 4, spatial differentiation of the drawing frame is carried out in quest of a normal coordinate point of a drawing, line tracking is performed from a normal coordinate point about this spatial differentiation picture, and angle distortion at the time of a drawing input by the image reader 1 is amended.

[0010]

[Function]In the invention of claim 1, the image-processing exclusive processor 4 counts the number of the pixels stored in the memory 2 corresponding to a drawing frame, for example, the number of pixels with which a black pixel appears continuously, i.e., a histogram, and searches for the normal coordinate point of a drawing based on the histogram. Therefore, the first point that a black pixel appears continuously turns into a normal coordinate point of a drawing.

[0011]In the invention of claim 2, the correction angle which amends inclination between a actual drawing and the drawing read by the image reader 1 by the ratio of the horizontal counted value from a normal coordinate point to vertical counted value can be found.

[0012]In the invention of claim 3, about a spatial differentiation picture, line tracking is performed and, thereby, the angle distortion at the time of a drawing input is amended from a normal coordinate point.

[0013]

[Example]

Example 1. (claim 1 correspondence)

Drawing 3 is a block diagram showing the example of the administration-of-drawings system which adopted the administration-of-drawings method of this invention. The memory which stores the image reader in which 1 reads a drawing, and the pixel which constitutes the picture of the drawing in which 2 was read by the image reader 1 in drawing 3, CPU to which 3 performs data processing between the image reader 1 and the memory 2, etc. (central processing unit), 4 is an image-processing exclusive processor which performs processing etc. which count the histogram about the number of the pixels in the memory 2 corresponding to the drawing frame drawn in the drawing, and search for the normal coordinate point of a drawing based on this counted histogram.

[0014]Drawing 1 is a figure showing the state of the two-dimensional array within the above-mentioned memory 2 of the drawing frame drawn on the drawing, and the field AX in drawing 1 and AY (drawing frame) are the figures to which the neighborhood of the point O of drawing 5 was expanded. The field AX and the figure containing AY are read by the image reader 1 shown in drawing 3, and are stored as the black pixel and white picture element of a picture in the memory 2 by processing of CPU3. That is, since the field AX and AY (drawing frame) are displayed black in practice, a black pixel is comprised, and other portions comprise a white picture element. Therefore, the logic "1" which shows a black pixel, and the logic "0" which shows a white picture element are stored in the memory 2. In drawing 1, the point O1 shows the drawing end (it corresponds to the point O1 of drawing 5) within the memory 2.

[0015]Since the point X1 is only a white picture element when it counts 1 pixel of histograms (the number of black pixels) of the direction of Y at a time for the inside of the two-dimensional memory 2 by the image-processing exclusive processor 4 in the direction of X, a histogram value is usually "0." Since the point X1 is reached and it becomes the black pixel of a drawing frame, it begins and a histogram counts. The memory addresses at this time (X1, Y1) are coordinates of the point O, and this point O can consider it as the normal coordinate point of a drawing. Since a black pixel may exist as a noise in a drawing, it is necessary to make into a normal coordinate point the point that a histogram increases continuously. That is, since the black pixel detected when the histogram of the direction of Y was set to "0" to the scan of the subsequent direction of X may be a noise even if the number of black pixels counts first, it does not become considering the point of the detection black pixel as a normal coordinate point.

[0016]Example 2. (claim 2 correspondence)

The normal coordinate point O of a drawing (X1, Y1) is detected by the processing mentioned above, and it counts 1 pixel of pixels at a time for the inside of a drawing horizontally (the direction of X) to this normal coordinate point O (X1, Y1), and, also perpendicularly (the direction of Y), a pixel is counted corresponding to horizontal counted value. To X2 after the point X1 of the direction of X, X3, ..., XM, the counted value (histogram) of the black pixel of the direction of Y increases continuously, and if the point XM is exceeded, specifically, it will become constant value. The length equivalent to this constant value turns into the length YN of the direction of Y in drawing 1.

[0017]It is $YN = YN1 + YN2$ and they are $YN1 = W1 / \sin\theta$, and $YN2 = W2 / \cos\theta$ so that clearly also from drawing 1. However, W1 is the width of the drawing frame AY, and W2 is the width of the drawing frame AX. Generally, the error angle θ is dramatically small and is 3 times or less. At this time, it will be $\sin\theta = 0.05$ and $\cos\theta \approx 1$, and if reading accuracy of a

general image reader is set to mm in 16 dots /, it will be about 2 mm, and the width of a common drawing frame is set to $W1=W2=32$, it will be $YN1=640$ and $YN2=32$ and will be set to $YN*YN1$. It is $YN3<YN2$ and is set to $\tan\theta=(XM-X1)/(YN1+YN3) ** (XM-X1)/YN$. However, XM is the point that the histogram value of the direction of Y becomes fixed. Therefore, the error angle theta can be found from the difference of the point X1 which a black pixel counts first, and the point XM that a histogram value becomes fixed, and the counted value YN of the black pixel of the direction of Y in the point XM. That is, the correction angle theta which amends inclination between a actual drawing and the drawing read by the image reader 1 from the ratio of the counted value of the direction of X to the counted value of the direction of Y can be found.

[0018]In the case of this Example 2, calculation of $\tan\theta$ requires only 1 time, and the conversion to each pixel becomes unnecessary like Hough transformation, and it can attain improvement in the speed of processing. If the error angle theta shown in drawing 1 can be found, angle correction will become possible when only theta carries out the RLC of the drawing frame AX and the AY a center [the point O].

[0019]As shown in drawing 2, drawing frame AX' and when AY inclines, the normal coordinate point OP can be found like the case where it is drawing 1, but this point OP is equivalent to the point OP in drawing 5. In this case, after carrying out angle correction, it can ask for the Y coordinate of the point O in drawing 1 by counting the number of black pixels of the frame of the direction of Y, and drawing a line from the Y coordinate of the point OP to down [of the direction of Y].

[0020]Although it is distinction the case of drawing 1, and in the case of drawing 2, it is distinguishable with the value of the Y coordinate of a normal coordinate point. That is, it is inclination of a drawing frame if it is more than a fixed value with the value of a Y coordinate, as shown in drawing 2, and if it is less than a certain fixed value, it is distinguishable that it is inclination of a drawing frame as shown in drawing 1. The correction angle in the case of drawing 1 is a RLC, and, in the case of drawing 2, it becomes a RRC.

[0021]The value of YN mentioned above, X1, ..., XM, and Y1 grade is inputted by the image reader 1 in drawing 3, and is stored in the memory 2 by CPU3, and a normal coordinate point and the error angle theta are searched for by processing of the image-processing exclusive processor 4.

[0022]Example 3. (claim 3 correspondence)

Next, spatial differentiation of the drawing frame is carried out, line tracking is performed from a normal coordinate point about this spatial differentiation picture, and Example 3 which amends the angle distortion at the time of the drawing input by the image reader 1 is described. By processing explained in Example 1, the normal coordinate point (X1, Y1) shown in drawing 4 is searched for, and this coordinate value is stored in the memory 2. Next, the edge line EG is extracted by carrying out spatial differentiation of the drawing frame AX and the AY for example, by ZOBERU differentiation. If line tracking (tracking) of the pixel on an edge line is carried out in the direction which a Y coordinate increases from the point X1 of the point of this edge line EG, for example, line tracking is carried out to the point XM and the coordinates of the point of the Y coordinate of the edge line EG in the point XM are set to YM. Since the error angle theta can be found in $\tan\theta=(XM-X1)/(YM-Y1)$, if only theta carries out the RLC of the drawing frame AX and the AY a center [a point (X1, Y1)], the angle distortion at the time of the drawing input by the image reader 1 can be amended.

[0023]

[Effect of the Invention]As mentioned above, by the invention of claim 1, the histogram of a drawing frame is counted and the normal coordinate point of the drawing was searched for based on this histogram.

Therefore, a normal coordinate point can be detected at high speed, and the effect that administration-of-drawings processing accelerates is acquired.

[0024]In the invention of claim 2, it counts 1 pixel of pixels at a time for the inside of a drawing horizontally to the normal coordinate point searched for, Also perpendicularly corresponding to horizontal counted value, a pixel is counted, and the correction angle which amends inclination between a actual drawing and the drawing read by the image reader was searched for based on the ratio of horizontal counted value to vertical counted value.

Therefore, compared with the method using the conventional Hough transformation, inclination of the drawing at the time of an input can be amended at high speed, and the effect that administration-of-drawings processing accelerates is acquired.

[0025]In the invention of claim 3, spatial differentiation of the drawing frame is carried out, line tracking is performed from a normal coordinate point about this spatial differentiation picture, and the angle distortion at the time of the drawing input by an image reader was amended. Therefore, compared with the method using the conventional Hough transformation, the angle distortion at the time of a drawing input can be amended at high speed, and the effect that administration-of-drawings processing accelerates is acquired.

TECHNICAL FIELD

[Industrial Application]This invention relates to the administration-of-drawings method in the administration-of-drawings system which manages drawings, such as a map and a circuit diagram.

PRIOR ART

[Description of the Prior Art]As drawings, such as a map and a circuit diagram, are generally shown in drawing 5, the drawing frame AV exists in the drawing P, and the figure is drawn in the drawing frame AV. When it stores this drawing P in the memory (not shown) of an administration-of-drawings system, the drawing P is read by image reader IR shown in drawing 6, and the white picture element and black pixel on the drawing P are identified and stored in a memory. Although the reading accuracy of image reader IR differs depending on the model of each image reader, generally the thing of 10 or more dots/mm of accuracy is used now. When reading the drawing P into image reader IR, along with the guide G1 of image reader IR, and G2, the drawing P is usually read, but it is impossible to make the drawing P read completely in parallel with the guide G1 and G2, and the frame and the guide G1 of the drawing P are usually read with the error of the minute angle theta.

[0003]For this reason, as shown in drawing 7, within a memory, the drawing P will be stored in the form where only theta shifted horizontally. Generally the coordinates (X, Y) of the point PO in the drawing P are expressed with the distance of the direction of X of the point PO, and the direction of Y by making into the starting point the point O in drawing 7 which the door post of the drawing P and a transversal frame cross. For this reason, if an error produces only angle theta

as mentioned above, about an X coordinate, the error of $|a1-a2|$ will be produced [the case where the drawing frame AV is made into a normal coordinate]. It is the same also about a Y coordinate. In order to amend this error, the Hough (Hough) conversion algorithms are used conventionally. Namely, according to the formula of $\rho = X \cos \theta + Y \sin \theta$, and $\sin \theta$ of Hough transformation, the neighborhood A1 of the vertical axis of the drawing frame AV is scanned, Hough transformation is performed to each pixel of a drawing door post, and the error angle θ is amended from X and Y flat surface by changing into a flat surface (ρ, θ) and asking for the angle θ 1 (refer to drawing 8) to the error angle θ on a flat surface (ρ, θ). Since the algorithm of the inclination correction by Hough transformation is an algorithm generally used, explanation is omitted here.

[0004]The relation between a rectangular coordinate system and a polar coordinate system is shown in drawing 8. In the X-Y rectangular coordinate system shown in drawing 8 (a), inclination and the point (X0, Y0) of as opposed to [in the distance to the straight line L and $\theta = 1 / \sin \theta$] the X-axis of the altitude to the straight line L from the starting point show the intersection of the straight line L and an altitude. In the ρ - θ polar coordinate system shown in drawing 8 (b), a point (ρ 1, θ 1) shows the point corresponding to the point (X0, Y0) in drawing 8 (a). Therefore, a relation called $\rho = X0 \cos \theta + Y0 \sin \theta$ is materialized.

EFFECT OF THE INVENTION

[Effect of the Invention]As mentioned above, by the invention of claim 1, the histogram of a drawing frame is counted and the normal coordinate point of the drawing was searched for based on this histogram.

Therefore, a normal coordinate point can be detected at high speed, and the effect that administration-of-drawings processing accelerates is acquired.

[0024]In the invention of claim 2, it counts 1 pixel of pixels at a time for the inside of a drawing horizontally to the normal coordinate point searched for, Also perpendicularly corresponding to horizontal counted value, a pixel is counted, and the correction angle which amends inclination between a actual drawing and the drawing read by the image reader was searched for based on the ratio of horizontal counted value to vertical counted value. Therefore, compared with the method using the conventional Hough transformation, inclination of the drawing at the time of an input can be amended at high speed, and the effect that administration-of-drawings processing accelerates is acquired.

[0025]In the invention of claim 3, spatial differentiation of the drawing frame is carried out, line tracking is performed from a normal coordinate point about this spatial differentiation picture, and the angle distortion at the time of the drawing input by an image reader was amended. Therefore, compared with the method using the conventional Hough transformation, the angle distortion at the time of a drawing input can be amended at high speed, and the effect that administration-of-drawings processing accelerates is acquired.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]As explained above, in order to perform inclination correction (angle correction) of a actual drawing and the drawing stored in the memory read by

the image reader using Hough transformation, by the conventional administration-of-drawings method, trigonometric-functions calculation of $\cos\theta$ or $\sin\theta$ is needed. In order to perform such functional calculus at high speed, it is necessary to equip an administration-of-drawings system with the hardware only for functional calculus, and it will become expensive in cost. In order to realize by software using CPU in an administration-of-drawings system, it is necessary to perform math processing of $\cos\theta$ and $\sin\theta$ about each point on a straight line, and administration-of-drawings processing takes much time.

[0006]It was made in order that this invention might solve above SUBJECT, and it aims at providing the administration-of-drawings method which can amend inclination of the drawing at the time of an input at high speed while the normal coordinate point on a drawing is detectable at high speed.

MEANS

[Means for Solving the Problem]In an administration-of-drawings method concerning an invention of claim 1, by forming the image-processing exclusive processor 4, A histogram about the number of pixels in the memory 2 corresponding to a drawing frame drawn in a drawing is counted, and a normal coordinate point of a drawing is searched for based on this counted histogram.

[0008]In an administration-of-drawings method concerning an invention of claim 2, by forming the image-processing exclusive processor 4, Search for a normal coordinate point of a drawing and it counts 1 pixel of pixels at a time for inside of a drawing horizontally to this normal coordinate point searched for, Also perpendicularly corresponding to horizontal counted value, a pixel is counted, and a correction angle which amends inclination between a actual drawing and a drawing read by the image reader 1 is searched for based on a ratio of horizontal counted value to vertical counted value.

[0009]In an administration-of-drawings method concerning an invention of claim 3, by forming the image-processing exclusive processor 4, spatial differentiation of the drawing frame is carried out in quest of a normal coordinate point of a drawing, line tracking is performed from a normal coordinate point about this spatial differentiation picture, and angle distortion at the time of a drawing input by the image reader 1 is amended.

OPERATION

[Function]In the invention of claim 1, the image-processing exclusive processor 4 counts the number of the pixels stored in the memory 2 corresponding to a drawing frame, for example, the number of pixels with which a black pixel appears continuously, i.e., a histogram, and searches for the normal coordinate point of a drawing based on the histogram. Therefore, the first point that a black pixel appears continuously turns into a normal coordinate point of a drawing.

[0011]In the invention of claim 2, the correction angle which amends inclination between a actual drawing and the drawing read by the image reader 1 by the ratio of the horizontal counted value from a normal coordinate point to vertical counted value can be found.

[0012]In the invention of claim 3, about a spatial differentiation picture, line tracking is performed and, thereby, the angle distortion at the time of a drawing input is amended from a normal coordinate point.

EXAMPLE

[Example]

Example 1. (claim 1 correspondence)

Drawing 3 is a block diagram showing the example of the administration-of-drawings system which adopted the administration-of-drawings method of this invention. The memory which stores the image reader in which 1 reads a drawing, and the pixel which constitutes the picture of the drawing in which 2 was read by the image reader 1 in drawing 3, CPU to which 3 performs data processing between the image reader 1 and the memory 2, etc. (central processing unit), 4 is an image-processing exclusive processor which performs processing etc. which count the histogram about the number of the pixels in the memory 2 corresponding to the drawing frame drawn in the drawing, and search for the normal coordinate point of a drawing based on this counted histogram.

[0014]Drawing 1 is a figure showing the state of the two-dimensional array within the above-mentioned memory 2 of the drawing frame drawn on the drawing, and the field AX in drawing 1 and AY (drawing frame) are the figures to which the neighborhood of the point O of drawing 5 was expanded. The field AX and the figure containing AY are read by the image reader 1 shown in drawing 3, and are stored as the black pixel and white picture element of a picture in the memory 2 by processing of CPU3. That is, since the field AX and AY (drawing frame) are displayed black in practice, a black pixel is comprised, and other portions comprise a white picture element. Therefore, the logic "1" which shows a black pixel, and the logic "0" which shows a white picture element are stored in the memory 2. In drawing 1, the point O1 shows the drawing end (it corresponds to the point O1 of drawing 5) within the memory 2.

[0015]Since the point X1 is only a white picture element when it counts 1 pixel of histograms (the number of black pixels) of the direction of Y at a time for the inside of the two-dimensional memory 2 by the image-processing exclusive processor 4 in the direction of X, a histogram value is usually "0." Since the point X1 is reached and it becomes the black pixel of a drawing frame, it begins and a histogram counts. The memory addresses at this time (X1, Y1) are coordinates of the point O, and this point O can consider it as the normal coordinate point of a drawing. Since a black pixel may exist as a noise in a drawing, it is necessary to make into a normal coordinate point the point that a histogram increases continuously. That is, since the black pixel detected when the histogram of the direction of Y was set to "0" to the scan of the subsequent direction of X may be a noise even if the number of black pixels counts first, it does not become considering the point of the detection black pixel as a normal coordinate point.

[0016]Example 2. (claim 2 correspondence)

The normal coordinate point O of a drawing (X1, Y1) is detected by the processing mentioned above, and it counts 1 pixel of pixels at a time for the inside of a drawing horizontally (the direction of X) to this normal coordinate point O (X1, Y1), and, also perpendicularly (the direction of Y), a pixel is counted corresponding to horizontal counted value. To X2 after the point X1 of the direction of X, X3, ..., XM, the counted value (histogram) of the black pixel of the direction of Y increases continuously, and if the point XM is exceeded, specifically, it will become constant value. The length equivalent to this constant value turns into the length YN of the direction of Y in drawing 1.

[0017]It is $YN = YN1 + YN2$ and they are $YN1 = W1 / \sin\theta$, and $YN2 = W2 / \cos\theta$ so that clearly also from drawing 1. However, W1 is the width of the drawing frame AY, and W2 is the

width of the drawing frame AX. Generally, the error angle theta is dramatically small and is 3 times or less. At this time, it will be $\sin\theta=0.05$ and $\cos\theta \approx 1$, and if reading accuracy of a general image reader is set to mm in 16 dots /, it will be about 2 mm, and the width of a common drawing frame is set to $W1=W2=32$, it will be $YN1=640$ and $YN2=32$ and will be set to $YN \approx YN1$. It is $YN3 < YN2$ and is set to $\tan\theta = (XM-X1)/(YN1+YN3) \approx (XM-X1)/YN$. However, XM is the point that the histogram value of the direction of Y becomes fixed. Therefore, the error angle theta can be found from the difference of the point X1 which a black pixel counts first, and the point XM that a histogram value becomes fixed, and the counted value YN of the black pixel of the direction of Y in the point XM. That is, the correction angle theta which amends inclination between a actual drawing and the drawing read by the image reader 1 from the ratio of the counted value of the direction of X to the counted value of the direction of Y can be found.

[0018] In the case of this Example 2, calculation of $\tan\theta$ requires only 1 time, and the conversion to each pixel becomes unnecessary like Hough transformation, and it can attain improvement in the speed of processing. If the error angle theta shown in drawing 1 can be found, angle correction will become possible when only theta carries out the RLC of the drawing frame AX and the AY a center [the point O].

[0019] As shown in drawing 2, drawing frame AX' and when AY inclines, the normal coordinate point OP can be found like the case where it is drawing 1, but this point OP is equivalent to the point OP in drawing 5. In this case, after carrying out angle correction, it can ask for the Y coordinate of the point O in drawing 1 by counting the number of black pixels of the frame of the direction of Y, and drawing a line from the Y coordinate of the point OP to down [of the direction of Y].

[0020] Although it is distinction the case of drawing 1, and in the case of drawing 2, it is distinguishable with the value of the Y coordinate of a normal coordinate point. That is, it is inclination of a drawing frame if it is more than a fixed value with the value of a Y coordinate, as shown in drawing 2, and if it is less than a certain fixed value, it is distinguishable that it is inclination of a drawing frame as shown in drawing 1. The correction angle in the case of drawing 1 is a RLC, and, in the case of drawing 2, it becomes a RRC.

[0021] The value of YN mentioned above, X1, ..., XM, and Y1 grade is inputted by the image reader 1 in drawing 3, and is stored in the memory 2 by CPU3, and a normal coordinate point and the error angle theta are searched for by processing of the image-processing exclusive processor 4.

[0022] Example 3. (claim 3 correspondence)

Next, spatial differentiation of the drawing frame is carried out, line tracking is performed from a normal coordinate point about this spatial differentiation picture, and Example 3 which amends the angle distortion at the time of the drawing input by the image reader 1 is described. By processing explained in Example 1, the normal coordinate point (X1, Y1) shown in drawing 4 is searched for, and this coordinate value is stored in the memory 2. Next, the edge line EG is extracted by carrying out spatial differentiation of the drawing frame AX and the AY for example, by ZOBERU differentiation. If line tracking (tracking) of the pixel on an edge line is carried out in the direction which a Y coordinate increases from the point X1 of the point of this edge line EG, for example, line tracking is carried out to the point XM and the coordinates of the point of the Y coordinate of the edge line EG in the point XM are set to YM. Since the error angle theta can be found in $\tan\theta = (XM-X1)/(YM-Y1)$, if only theta carries out the RLC of the drawing frame AX and the AY a center [a point (X1, Y1)], the angle distortion at the time of

the drawing input by the image reader 1 can be amended.
[0023]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is a figure showing the state of the two-dimensional array within the memory of the drawing frame in Examples 1 and 2 by the administration-of-drawings method of this invention.

[Drawing 2] The case where it is shown in drawing 1 is a figure showing the state of the two-dimensional array within the memory of the drawing frame leaning to the opposite direction.

[Drawing 3] It is a block diagram showing the example of the administration-of-drawings system which adopted the administration-of-drawings method of this invention.

[Drawing 4] They are spatial differentiation and an explanatory view which carries out line tracking about the drawing frame in Example 3.

[Drawing 5] It is a figure showing a common map, a circuit diagram, etc.

[Drawing 6] It is a figure for explaining processing by the conventional administration-of-drawings method.

[Drawing 7] It is a figure showing the state of the two-dimensional array within the memory of the drawing frame in this conventional example.

[Drawing 8] It is a figure for explaining Hough transformation.

[Description of Notations]

1 Image reader

2 Memory

3 Central processing unit

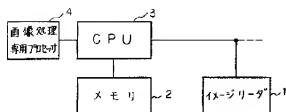
4 Image-processing exclusive processor

AX, AY, AX' drawing frame

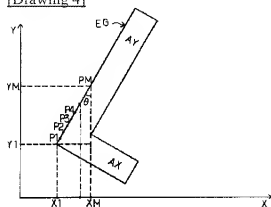
O and OP Normal coordinate point

theta Correction angle

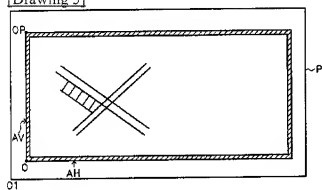
DRAWINGS



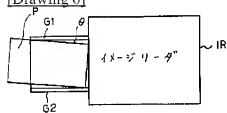
[Drawing 4]



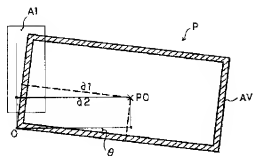
[Drawing 5]



[Drawing 6]

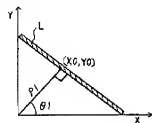


[Drawing 7]

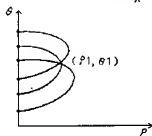


[Drawing 8]

(a)



(b)



[Translation done.]

Your Ref: 07844-249JP1
Our Ref: PA941

**Translation of Selected Portions of
Pat. Laid-open Official Gazette**

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Inventor(s): Hatsuhiko Naito
Applicant(s): Mitsubishi Electric K.K.
Attorney(s): Junichi Miyazono

1. Title of the Invention

SYSTEM FOR MANAGING DRAWINGS

2. Claims

(omitted)

3. Detailed Description of the Invention (Selected Portions)

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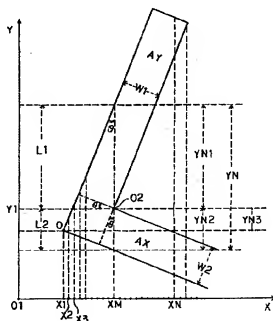
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(54)【発明の名称】 図面管理方式

(57)【要約】

【目的】 図面の基準座標点を高速に検出可能にするとともに、図面入力時の角度の傾きを高速に補正できるようにする。

【構成】 図面枠AX, AYが黒で描画されていることに着目し、図面枠の画素が格納されたメモリ内をX方向に走査し、Y方向の黒画素数(ヒストグラム)をカウントし、最初の連続してヒストグラムの表れる座標点を図面の基準座標点Oとする。また、X方向の走査画素数とY方向のヒストグラムの値との比により図面の入力時の傾き角(補正角) θ を求め、基準座標点を中心として回転することにより角度補正する。また、図面枠を空間微分し、この空間微分画像に関して基準座標点より線追跡を行い、傾き角を求め、角度補正する。



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【特許請求の範囲】

【請求項1】 図面を読み取るイメージリードと、このイメージリードにより読み取られた図面の画像を構成する画素を格納するメモリと、上記イメージリードと上記メモリ間のデータ処理等を行う中央処理装置とを備えた図面管理システムにおいて、画像処理専用プロセッサを設けることにより、図面内に描かれた図面枠に対応する上記メモリ内の画素の数に関するヒストグラムをカウントし、このカウントされたヒストグラムに基づいて図面の基準座標点を求めることを特徴とする図面管理方式。

【請求項2】 図面を読み取るイメージリードと、このイメージリードにより読み取られた図面の画像を構成する画素を格納するメモリと、上記イメージリードと上記メモリ間のデータ処理等を行う中央処理装置とを備えた図面管理システムにおいて、画像処理専用プロセッサを設けることにより、図面内に描かれた図面枠に対応する上記メモリ内の画素の数に関するヒストグラムをカウントし、このカウントされたヒストグラムに基づいて図面の基準座標点を求め、この求められた基準座標点に対して図面内を水平方向に1画素ずつ画素をカウントし、また水平方向のカウント値に対して垂直方向にも画素をカウントし、水平方向のカウント値と垂直方向のカウント値の比に基づいて実際の図面と上記イメージリードで読み取られた図面の間の傾きを補正するための補正角を求めることを特徴とする図面管理方式。

【請求項3】 図面を読み取るイメージリードと、このイメージリードにより読み取られた図面の画像を構成する画素を格納するメモリと、上記イメージリードと上記メモリ間のデータ処理等を行う中央処理装置とを備えた図面管理システムにおいて、画像処理専用プロセッサを設けることにより、図面内に描かれた図面枠に対応する上記メモリ内の画素の数に関するヒストグラムをカウントし、このカウントされたヒストグラムに基づいて図面の基準座標点を求め、図面枠を空間微分し、この空間微分画像に関して上記基準座標点より線追跡を行い、上記イメージリードによる図面入力時の角度歪みを補正することを特徴とする図面管理方式。

【発明の詳細な説明】

【0001】

【産業上の利用分野】 本発明は地図や回路図などの図面を管理する図面管理システムにおける図面管理方式に関するものである。

【0002】

【従来の技術】 一般に地図や回路図等のような図面は図5に示されるように図面枠A Vが図面P内に存在し、図面枠A Vの中図形が描かれている。この図面Pを図面管理システムのメモリ（図示せず）に格納する場合、図6に示すイメージリードI Rにより図面Pを読み込み、メモリ内に図面P上の白画素と黒画素とを識別して格納する。イメージリードI Rの読み取り精度は各イメージ

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リードの機種によって異なるが、一般に10ドット/mm以上の精度のものが現在使用されている。イメージリードI Rに図面Pを読み込む際、通常イメージリードI RのガイドG 1、G 2に沿って図面Pを読み込むが、完全にガイドG 1、G 2に平行に図面Pを読み込ませることは不可能であり、通常図面Pの枠とガイドG 1とは微小角 θ の誤差を持って読み込まれる。

【0003】 このため図7に示すようにメモリ内では図面Pは水平方向から θ だけずれた形で格納されることになる。一般に図面P内の点P Oの座標(X, Y)は図面Pの縦枠と横枠の交わる図7内の点Oを原点として点P OのX方向、Y方向の距離で表される。このため上述のように角 θ だけ誤差が生じると図面枠A Vを基準座標とした場合に比較して例えばX座標に関しては $|a1 - a2|$ の誤差を生じる。Y座標に関しても同様である。この誤差を補正するために従来はハフ(Hough)変換アルゴリズムを利用している。すなわちハフ変換の公式 $\rho = X0 \cdot \cos \theta + Y0 \cdot \sin \theta$ の式に依り例えば図面枠A Vの縦軸の近傍A 1を走査し、図面縦枠の各画素点に対しハフ変換を施しX, Y平面より、 (ρ, θ) の平面上で、誤差角 θ に対する角 $\theta 1$ (図8参照)を求めることにより誤差角 θ を補正する。ハフ変換による傾き補正のアルゴリズムは一般に用いられているアルゴリズムであるので、ここでは説明を省略する。

【0004】 なお、直交座標系と極座標系の関係は図8に示す。図8(a)に示すX-Y直交座標系において、 $\rho 1$ は原点より直線Lへの距離、 $\theta 1$ は直線Lへの垂線のX軸に対する傾き、点(X0, Y0)は直線Lと垂線の交点を示す。また図8(b)に示す $\rho-\theta$ 極座標系において、点 $(\rho 1, \theta 1)$ は図8(a)中の点(X0, Y0)に対応する点を示す。したがって、 $\rho 1 = X0 \cdot \cos \theta 1 + Y0 \cdot \sin \theta 1$ という関係が成立する。

【0005】

【発明が解決しようとする課題】 以上説明したように従来の図面管理方式では、実際の図面とイメージリードで読み取られたメモリに格納される図面との傾き補正(角度補正)はハフ変換を用いて行うため、 $\cos \theta$ や $\sin \theta$ の三角関数計算が必要になる。このような関数計算を高速に実行させるためには関数計算専用のハードウェアを図面管理システムに備える必要があり、コスト的に高価なものとなる。また図面管理システム内のCPUを用いソフトウェア的に実現するためには、 $\cos \theta$ 、 $\sin \theta$ の数値演算を直線上の各点に開行し行う必要があり、図面管理処理に多くの時間を要する。

【0006】 この発明は上記のような課題を解決するためになされたもので、図面上の基準座標点を高速に検出することができるとともに入力時の図面の傾きを高速に補正することができる図面管理方式を提供することを目的とする。

【0007】

【課題を解決するための手段】請求項1の発明に係る図面管理方式では、画像処理専用プロセッサ4を設けることにより、図面内に描かれた図面枠に対応するメモリ2内の画素の数に関するヒストグラムをカウントし、このカウントされたヒストグラムに基づいて図面の基準座標点を求めるようになっている。

【0008】請求項2の発明に係る図面管理方式では、画像処理専用プロセッサ4を設けることにより、図面の基準座標点を求め、この求められた基準座標点に対して図面内を水平方向に1画素づつ画素をカウントし、また水平方向のカウント値に対応して垂直方向にも画素をカウントし、水平方向のカウント値と垂直方向のカウント値の比に基づいて実際の図面とイメージリダ1で読み取られた図面の間の傾きを補正する補正角を求めるようになっている。

【0009】請求項3の発明に係る図面管理方式では、画像処理専用プロセッサ4を設けることにより、図面の基準座標点を求め図面枠を空間微分し、この空間微分画像に関して基準座標点より線追跡を行い、イメージリダ1による図面入力時の角度歪みを補正するようになっている。

【0010】

【発明】請求項1の発明においては、画像処理専用プロセッサ4は図面枠に対応するメモリ2に格納された画素の数、例えば黒画素が連続して表れる画素の数、即ちヒストグラムをカウントし、そのヒストグラムに基づいて図面の基準座標点を求める。したがって、黒画素が連続して表れる最初の点が図面の基準座標点となる。

【0011】請求項2の発明においては、基準座標点からの水平方向のカウント値と垂直方向のカウント値の比によって、実際の図面とイメージリダ1で読み取られた図面の間の傾きを補正する補正角が求まる。

【0012】請求項3の発明においては、空間微分画像に関して基準座標点より線追跡が行われ、これにより図面入力時の角度歪みが補正される。

【0013】

【実施例】

実施例1。(請求項1対応)

図3はこの発明の図面管理方式を採用した図面管理システムの実施例を示すブロック図である。図3において、1は図面を読み取るイメージリダ、2はイメージリダ1により読み取られた図面の画像を構成する画素を格納するメモリ、3はイメージリダ1とメモリ2間のデータ処理等を行うCPU(中央処理装置)、4は図面内に描かれた図面枠に対応するメモリ2内の画素の数に関するヒストグラムをカウントし、このカウントされたヒストグラムに基づいて図面の基準座標点を求める処理等を行う画像処理専用プロセッサである。

【0014】図1は図面に描かれた図面枠の上記メモリ

2内での2次元配列の状態を示す図で、図1における領域AX、AY(図面枠)は図5の点Oの近傍を拡大した図である。領域AX、AYを含む図3に示すイメージリダ1によって読み込まれ、CPU3の処理によりメモリ2内に画像の黒画素及び白画素として格納される。即ち、領域AX、AY(図面枠)は、実際は黒で表示されるので黒画素から成り、その他の部分は白画素から成る。したがって、メモリ2には黒画素を示す論理「1」と白画素を示す論理「0」が格納される。また、図1において、点O1はメモリ2内での図面端(図5の点O1に対応)を示す。

【0015】2次元メモリ2内をX方向に1画素ずつY方向のヒストグラム(黒画素数)を画像処理専用プロセッサ4によってカウントすると、点X1までは白画素のみであるのでヒストグラム値は通常「0」である。点X1に達して図面枠の黒画素に達するので、始めてヒストグラムがカウントされる。この時のメモリアドレス(X1, Y1)が点Oの座標であり、この点Oが図面の基準座標点とすることができる。なお、図面内にはノイズとして黒画素が存在することもあるので、ヒストグラムが連続して増大する点を基準座標点とすることがある。即ち黒画素数が最初にカウントされても、その後のX方向の走査に対してY方向のヒストグラムが「0」になれば検出した黒画素はノイズである可能性があるため、その検出黒画素の点を基準座標点としてはならない。

【0016】実施例2。(請求項2対応)

上述した処理により図面の基準座標点O(X1, Y1)が検出され、この基準座標点O(X1, Y1)に対して図面内を水平方向(X方向)に1画素づつ画素をカウントし、また水平方向のカウント値に対応して垂直方向(Y方向)にも画素をカウントする。具体的には、X方向の点X1以降のX2, X3, ..., XMに対してはY方向の黒画素のカウント値(ヒストグラム)を増え続け、点XMを越えたと一定値になる。この一定値に相当する長さは図1中のY方向の長さYNとなる。

【0017】図1からも明らかなように、 $YN = YN1 + YN2$ であり、 $YN1 = W1 / \sin \theta$ 、 $YN2 = W2 / \cos \theta$ である。ただし、W1は図面枠AYの幅、W2は図面枠AXの幅である。一般に誤差角 θ は非常に小さく、3度以下である。この時、 $\sin \theta = 0.0$ 、 $\cos \theta \approx 1$ であり、一般の図面枠の幅は2.0mm程度であり、一般のイメージリダの読み取り精度を16ドット/mmとすると、 $W1 = W2 = 3.2$ となり、 $YN1 = 6.40$ 、 $YN2 = 3.2$ であり、 $YN \approx YN1$ となる。また、 $YN3 < YN2$ であり、 $\tan \theta = (XM - X1) / (YN1 + YN3) \approx (XM - X1) / YN$ となる。ただしXMはY方向のヒストグラム値が一定になる点である。したがって、最初に黒画素がカウントされる点X1とヒストグラム値が一定になる点XMの差と点XMでのY方向の黒画素のカウント値YNとから誤差

角 θ が求まる。即ち、X方向のカウント値とY方向のカウント値の比から実際の図面とイメージリダ1で読み取られた図面の間の傾きを補正する補正角 θ が求まる。

【0018】この実施例2の場合、 $\tan \theta$ の計算は1回だけで良く、ハフ変換のように各画素点に対する変換が不要になり、処理の高速化が図れる。図1に示す誤差角 θ が求まれば、点Oを中心として θ だけ図面枠AX、AYを左回転させることにより、角度補正が可能になる。

【0019】図2に示すように図面枠AX'、AYが傾いた場合、図1の場合と同様にして基準座標点OPが求まるが、この点OPは図5中の点OPに対応する。この場合、角度補正した後、Y方向の枠の黒画素数をカウントし、点OPのY座標よりY方向の下方向へ線を引くことにより、図1中の点OのY座標を求めることができる。

【0020】図1の場合と図2の場合の区別であるが、基準座標点のY座標の値で区別できる。即ち、Y座標の値がある一定の値以上であれば、図2に示すような図面枠の傾きであり、ある一定の値未満であれば図1に示すような図面枠の傾きであることが区別できる。図1の場合の補正角は左回転であり、図2の場合は右回転になる。

【0021】上述したYN、X1、・・・、XM、Y1等の値は図3におけるイメージリダ1により入力され、そしてCPU3によりメモリ2に格納され、基準座標点Oと誤差角 θ は画像処理専用プロセッサ4の処理により求められる。

【0022】実施例3。（請求項3対応）

次に、図面枠を空間微分し、この空間微分画像に関して基準座標点より線追跡を行い、イメージリダ1による図面入力時の角度歪みを補正する実施例3について説明する。実施例1で説明した処理により、図4に示す基準座標点(X1, Y1)を求め、この座標値をメモリ2に格納する。次に図面枠AX、AYを例えばソーベル微分により空間微分することによりエッジ線EGを抽出し、このエッジ線EGの先の点X1よりY座標の増加する方向にエッジ線上の画素を線追跡（トラッキング）し、例えば点XMまで線追跡し、点XMでのエッジ線EGのY座標の点の座標をYMとすれば、誤差角 $\theta = \tan \theta = (XM - X1) / (YM - Y1)$ が求まるので、点(X1, Y1)を中心に θ だけ図面枠AX、AYを左回転すれば、イメージリダ1による図面入力時の角度歪みを補正することができる。

【0023】

【発明の効果】以上のように請求項1の発明によれば、図面枠のヒストグラムをカウントし、このヒストグラムに基づいて図面の基準座標点を求めるようにしたので、基準座標点を高速に検出することができ、図面管理処理が高速化するという効果が得られる。

【0024】請求項2の発明によれば、求められた基準座標点に対して図面内を水平方向に1画素ずつ画素をカウントし、また水平方向のカウント値に対応して垂直方向にも画素をカウントし、水平方向のカウント値と垂直方向のカウント値の比に基づいて実際の図面とイメージリダで読み取られた図面の間の傾きを補正する補正角を求めるようにしたので、従来のハフ変換を用いる方式に比べ、入力時の図面の傾きを高速に補正することができ、図面管理処理が高速化するという効果が得られる。

【0025】請求項3の発明によれば、図面枠を空間微分し、この空間微分画像に関して基準座標点より線追跡を行い、イメージリダによる図面入力時の角度歪みを補正するようにしたので、従来のハフ変換を用いる方式に比べ図面入力時の角度歪みを高速に補正でき、図面管理処理が高速化するという効果が得られる。

【図面の簡単な説明】

【図1】この発明の図面管理方式による実施例1、2における図面枠のメモリ内での2次元配列の状態を示す図である。

【図2】図1に示す場合は逆方向に傾いた図面枠のメモリ内での2次元配列の状態を示す図である。

【図3】この発明の図面管理方式を採用した図面管理システムの実施例を示すブロック図である。

【図4】実施例3における図面枠を空間微分及び線追跡する説明図である。

【図5】一般の地区や回路図等を示す図である。

【図6】従来の図面管理方式による処理を説明するための図である。

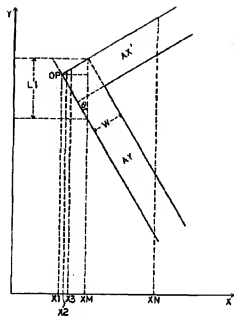
【図7】この従来例における図面枠のメモリ内での2次元配列の状態を示す図である。

【図8】ハフ変換を説明するための図である。

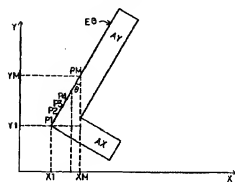
【符号の説明】

- 1 イメージリダ
- 2 メモリ
- 3 中央処理装置
- 4 画像処理専用プロセッサ
- AX, AY, AX' 図面枠
- O, OP 基準座標点
- θ 補正角

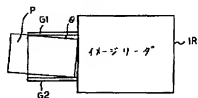
【図2】



【图4】



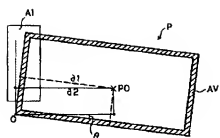
【例6】



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【圖 7】



【圖 8】

